STUDY OF PHYSICO- CHEMICAL CHARACTERISTICS AND PLANKTON BIO-DIVERSITY OF BADUA RESERVIOR, BANKA,BIHAR

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Synopsis

For The Award of

DOCTOR OF PHILOSOPHY

IN ZOOLOGY

UNDER THE FACULTY OF SCIENCE

POST GRADUATE DEPARTMENT OF ZOOLOGY

Lalit Narayan Mithila University

Kameshwara Nagar, Darbhanga

2024

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15/04/2024

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(2021-22)

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STUDY OF PHYSICO- CHEMICAL CHARACTERISTICS AND PLANKTON BIO-DIVERSITY OF BADUA RESERVIOR, BANKA,BIHAR

1.1 Introduction

Water bodies serve as critical ecosystems supporting a myriad of life forms and providing essential services to human societies. Among these, reservoirs represent artificial freshwater habitats created primarily for water storage, irrigation, hydropower generation, and other socio-economic activities. Despite their anthropogenic origins, reservoirs harbor diverse biological communities and contribute significantly to regional biodiversity and ecosystem functioning. Badua Reservoir, nestled in the scenic landscape of Banka district, Bihar, is a prominent example of such an artificial aquatic ecosystem constructed to meet the water needs of the local populace, Badua Reservoir has emerged as a focal point for scientific inquiry, conservation efforts, and sustainable resource management. The reservoir's ecological significance lies not only in its utility for water supply but also in its role as a habitat for diverse aquatic organisms, including planktonic communities. Plankton, comprising both phytoplankton and zooplankton, are microscopic organisms that form the foundation of aquatic food webs. Phytoplankton, primarily photosynthetic microalgae, harness solar energy to produce organic matter, serving as the primary producers in aquatic ecosystems. Zooplankton, on the other hand, are heterotrophic organisms that feed on phytoplankton, bacteria, and detritus, playing vital roles as grazers, nutrient recyclers, and prey for higher trophic levels.

The physicochemical properties of water play a fundamental role in shaping aquatic ecosystems. Parameters such as temperature, pH, dissolved oxygen, turbidity, nutrients (nitrogen, phosphorus), and salinity profoundly influence the ecological dynamics of water bodies. In the context of Badua Reservoir, studies have revealed fluctuations in these parameters due to various natural and anthropogenic factors. For instance, seasonal variations, agricultural runoff, and industrial activities can significantly impact water quality. Investigating these characteristics provides a baseline for assessing the reservoir's health and identifying potential stressors.

Plankton, comprising phytoplankton and zooplankton, constitutes the foundation of aquatic food webs and

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serves as indicators of ecosystem health. Phytoplankton, primarily composed of microalgae, are crucial for primary production and nutrient cycling. Zooplankton, including protozoans and small metazoans, are vital consumers and play a key role in energy transfer within aquatic ecosystems. Studies conducted in Badua Reservoir have documented diverse planktonic communities, influenced by nutrient availability, light penetration, and predation pressure. However, anthropogenic activities and environmental changes can perturb plankton biodiversity, leading to ecological imbalances.

The physicochemical characteristics of Badua Reservoir exert profound effects on plankton biodiversity and vice versa. For instance, nutrient levels influence phytoplankton abundance, which, in turn, affects DO levels through photosynthesis and respiration. Zooplankton grazing regulates phytoplankton populations, maintaining ecological balance. Furthermore, plankton serve as crucial food resources for higher trophic levels, including fish, thereby influencing fisheries productivity. Understanding these interactions is essential for holistic ecosystem management and sustainable development.

Zooplankton, comprising a myriad of microscopic organisms such as copepods, cladocerans, and rotifers, are integral components of aquatic food webs. Badua Reservoir hosts a rich assemblage of zooplankton species, influenced by environmental factors like temperature, nutrient availability, and predation pressure. Exploring the taxonomic diversity, abundance, and distribution patterns of zooplankton provides valuable insights into the reservoir's ecological dynamics. Zooplankton play pivotal roles in aquatic ecosystems, serving as primary consumers, nutrient recyclers, and prey for higher trophic levels. Grazing by zooplankton regulates phytoplankton populations, thereby influencing water clarity and nutrient cycling. Moreover, they serve as vital food resources for fish larvae and juvenile stages, contributing to fisheries productivity. Investigating the trophic interactions and functional roles of zooplankton elucidates their significance in maintaining ecosystem balance.

Zooplankton communities exhibit dynamic responses to environmental variability, including seasonal changes, nutrient inputs, and hydrological alterations. Shifts in species composition, abundance, and phenology reflect adaptations to prevailing conditions. Anthropogenic disturbances, such as pollution and habitat alteration, can disrupt zooplankton dynamics, leading to cascading effects on ecosystem structure

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The physicochemical properties of water play a fundamental role in shaping aquatic ecosystems. Parameters such as temperature, pH, dissolved oxygen, turbidity, nutrients (nitrogen, phosphorus), and salinity profoundly influence the ecological dynamics of water bodies. In the context of Badua Reservoir, studies have revealed fluctuations in these parameters due to various natural and anthropogenic factors. For instance, seasonal variations, agricultural runoff, and industrial activities can significantly impact water quality. Investigating these characteristics provides a baseline for assessing the reservoir's health and identifying potential stressors.

Plankton, comprising phytoplankton and zooplankton, constitutes the foundation of aquatic food webs and

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and function. Understanding these responses aids in assessing ecosystem resilience and guiding conservation efforts. The conservation of zooplankton biodiversity in Badua Reservoir is vital for preserving overall ecosystem health and function. Anthropogenic activities, such as agricultural runoff and industrial pollution, pose significant threats to zooplankton populations and aquatic biodiversity. Implementing measures to mitigate pollution, restore habitat quality, and promote sustainable resource management is imperative for safeguarding zooplankton diversity and ecosystem integrity.

1.2 Literature Review

Trivedi and Goyal,(1987), After collection and examination of samples various water parameters like temperature,pH, TDS, hardness and alkalinity. Further plankton where identified and zooplankton data was analysed by statistical tools such as Mean and Standard Deviation.

Khanna,(2012),He further stated that freshwater considered to be most significant component of earth. For locating best quality of water its physico-chemical and biological parameters are used. He further added that water maintain an ecological balance between various group of living Organism and their environment. He suggests that the physical and chemical characteristics of water bodies affect the composition of species productivity and physiological condition of aquatic Organism.

Stevenson, (1999), He said biological assessment is a significant alternative for accessing the ecological quality of aquatic ecosystem. He further added that the plankton are considered to be very sensitive to the environment where they live.

Shinde,(2001), He stated that water is abundant compound of the ecosystem. The living being is largely depend on the quality and purity of water.Hence in all cases it must be free from pollutants.

Amar Singhe and Viveberg, (2002), In their study they found that in reservoir a large variation in the composition of plankton occurred not only in different regions on different depths but also at different periodically time scale and seasons.

Akbay, (1999),Plankton is the most important characteristics of aquatic ecosystem for maintaining its stability and means of coping with any environmental change.

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Hambright and Zohary, (2000), According to their physical and chemical characteristics of water provides a considerable insight into the quality of water present in the reservoir. The increasing concentration of various chemicals in generating from the industries and their subsequent having negative impact on water eco system.

1.3 Objectives

The key objectives of the study will be

- To study the physico- chemicalcharacteristics of BaduaReservoir Water.
- To assess the diversity and abundance of zooplankton communities inhabiting the reservoir.
- To examine the influence of physicochemical factors on zooplankton distribution and abundance.
- To explore the ecological significance of zooplankton in the context of Badua Reservoir's ecosystem dynamics.

1.4Importance of The Study

The physicochemical characteristics of Badua Reservoir exert profound effects on plankton biodiversity and vice versa. For instance, nutrient levels influence phytoplankton abundance, which, in turn, affects DO levels through photosynthesis and respiration. Zooplankton grazing regulates phytoplankton populations, maintaining ecological balance. Furthermore, plankton serve as crucial food resources for higher trophic levels, including fish, thereby influencing fisheries productivity. Understanding these interactions is essential for holistic ecosystem management and sustainable development.

The present study will enable us to determine variation in physico chemical parameter of water and plankton diversity in Badua reservoir of Bihar. Plankton forms integral component of fresh water environment and contributes important role in biological productivity of the ecosystem. Various zooplankton will be identified in Badua reservoir.The physico-chemical characteristics which defines the aquatic environment have directly impact on the life of aquatic Organism. Slight deviation in these elements frequently generate

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an adverse environment with Organism, restricting their growth as well as disrupting the physiological process and this decrease their ability to grow. the present study will indicate that Badua reservoir will having ideal physico chemical parameter and plankton diversity which will support good fish production. Monitoring and management for the quality of water has been crucial phase for the conservation of aquatic ecosystem. Aquatic ecosystem management aims to conserve habitat while sustaining the physicochemical quality of water within acceptable limits. fish production depends directly on quality and quantity of natural food available in the environment. The production of plankton depends on various physicochemical parameters. which varies seasonally.Hence the importance of the study will be to make study the physical and chemical characteristics and plankton diversity of Badua Reservoir located near Bhagalpur in Bihar.

1.5 Problems to be Studied

Investigate the influence of agricultural runoff, industrial pollution, and urbanization on the physicochemical characteristics and plankton diversity of Badua Reservoir. Assess the extent of contamination, identify pollutant sources, and quantify their effects on water quality and ecosystem health. Examine the seasonal fluctuations in physicochemical parameters (e.g., temperature, dissolved oxygen, nutrient levels) and plankton abundance/diversity within Badua Reservoir. Determine the drivers of seasonal changes and their implications for ecosystem dynamics and biotic interactions.

Characterize the taxonomic composition, diversity, and spatial distribution of plankton communities in Badua Reservoir. Identify dominant species, assess community structure, and elucidate factors driving plankton assemblages' composition and dynamics. Explore the trophic relationships between planktonic organisms and their implications for energy transfer and nutrient cycling within the reservoir ecosystem. Investigate predator-prey interactions, trophic cascades, and the role of plankton in supporting higher trophic levels, particularly fish populations.

Evaluate the resilience of plankton communities in Badua Reservoir to environmental stressors such as pollution, eutrophication, and habitat degradation. Assess the adaptive capacity of plankton species and their potential role as bioindicators of ecosystem health and environmental quality. Quantify the ecological functions and services provided by planktonic communities in Badua Reservoir. Assess their contributions to

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potential role as bioindicators of ecosystem health and environmental quality. Quantify the ecological functions and services provided by planktonic communities in Badua Reservoir. Assess their contributions to primary production, nutrient cycling, water clarity, and fisheries productivity, and evaluate their importance for maintaining ecosystem stability and resilience. Identify key conservation challenges facing plankton biodiversity and water quality in Badua Reservoir. Propose evidence-based management strategies and mitigation measures to address these challenges, including pollution control, habitat restoration, and sustainable resource management practices.

1.6 Materials and Methods

Description of Study Area

The water and the plankton samples will be collected from **Badua Reservoir, Banka District, Bihar**

Badua reservoir 80km south of Bhagalpur Banka District(86^0 30' E and 25^0 30' N) has been commissioned in the year 1963 on Badua River, Banka District , Bihar. The reservoir has a surface area of 880 hectare. The maximum and mean depth being 32.0 m and 14.57 m respectively.

Badua Reservoir as monomictic having thermal stratification during summer and isothermal conditions during monsoon and winter months. Alkaline in reaction (7.5 to 8.1) the water is saturated with oxygen (80-100%) throughout the year. Oxygen depletion In the bottom layer is reported (5.6 to 6.9ml l^{-1}) accompanied by accumulation of nutrients. The maximum rate of primary productivity is at 0.5 m depth. The state fisheries department has been stocking the reservoir.

Reservoirs as a potential fisheries resource are yet to gain importance in Bihar. Documentation on reservoir fisheries resources in the state is not very comprehensive and exact, with the various estimates on the water area at variance with one another.

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- **Analysis of physio chemical characteristics of Badua Reservoir**

The surface water samples will be collected in sterile polyethylene bottle and will be kept in icebox and will be transported to the laboratory for the analysis of physico-chemical parameters. The water and plankton samples will be collected early morning (6:00 am- 7:00 am) every month first week during study. Air and water temperature, pH, salinity, dissolved oxygen, TDS, and electrical conductivity will be estimated by μ P based water and soil analysis kit. Water samples will be collected from various sites within Badua Reservoir and analysed for temperature, pH, dissolved oxygen, turbidity, nutrient levels (nitrogen and phosphorus), and other relevant parameters using standard laboratory techniques.

- **Zooplankton Sampling**

Zooplankton, being integral components of aquatic ecosystems, play crucial roles in nutrient cycling, energy transfer, and trophic dynamics. To comprehensively assess zooplankton diversity and abundance in Badua Reservoir, systematic sampling protocols will be employed. Plankton nets of appropriate mesh size will be deployed at designated sampling stations across the reservoir to capture zooplanktonic organisms effectively. Sampling stations will be strategically chosen to cover various habitat types, depth zones, and hydrological conditions, ensuring representative sampling of the reservoir's planktonic communities.

Sampling efforts will be conducted at different times of the day and across seasons to capture temporal variations in zooplankton distribution and abundance. Multiple replicates will be collected at each sampling site to account for spatial heterogeneity and ensure robust statistical analyses. Special attention will be paid to standardizing sampling techniques, including net towing speed, duration, and depth range, to minimize sampling biases and ensure data accuracy and reliability. Upon retrieval, zooplankton samples will be carefully preserved using appropriate fixation methods to maintain their morphological integrity and prevent decomposition. Samples will then be transported to the laboratory for further processing and analysis.

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In the laboratory, zooplankton samples will undergo meticulous processing to facilitate taxonomic identification and enumeration. Samples will be filtered through fine mesh sieves to concentrate zooplankton organisms and remove debris and sediment. Subsamples will be prepared for microscopic examination, ensuring comprehensive coverage of the planktonic community.Zooplankton specimens will be examined under a stereomicroscope or compound microscope for taxonomic identification to the lowest possible taxonomic level. Morphological characteristics, such as body shape, appendage structure, and ornamentation, will be scrutinized to distinguish between different zooplankton taxa. Taxonomic keys, atlases, and reference collections will be utilized to aid in species identification and ensure accuracy. Individual organisms will be enumerated, and abundance estimates will be recorded for each taxon encountered. Additionally, measurements of body size, biomass, and reproductive status may be conducted to provide additional insights into zooplankton ecology and population dynamics.

- **Data Analysis**

The collected data, including physicochemical parameters and zooplankton abundance/diversity metrics, will be subjected to rigorous statistical analyses to uncover patterns, relationships, and ecological trends. Multivariate statistical techniques, such as Principal Component Analysis (PCA) and Cluster Analysis, will be employed to explore patterns in physicochemical parameters and zooplankton community structure across sampling sites and seasons.Regression Modeling will be used to assess the relationships between physicochemical parameters (e.g., temperature, dissolved oxygen, nutrient concentrations) and zooplankton diversity indices .The data between zooplankton and physicochemical characteristics will be subjected to correlation and linear regression. Seasonal data will be subjected to statistical analysis by using one way ANOVA.

1.7 Work Plan

The present study will be divided and arranged in following six chapters

Chapter: 1 Introduction

This chapter will be introductory in nature. This chapter include objectives of the study, review of the literature, importance of the work followed by the work plan.

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1.7 Work Plan

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Chapter: 2 Material and Methodology

This chapter will highlight materials and methods and area of study

Below stated mathematical and statistical tools will be used

- Average
- Mean
- Standard Deviation
- Karl Pearson Coefficient of Correlation
- Regression Analysis
- ANOVA

Chapter: 3 Physico Chemical Characteristics and Plankton Biodiversity.

This chapter will analyse physicochemical characteristics and plankton biodiversity of Badua Reservoir, Banka Bihar.

Chapter: 4 Result

This chapter will present result after analysing physicochemical characteristics and zooplankton diversity of the Badua Reservoir.

Chapter: 5 Discussion

In this chapter discussion will be made on physicochemical characteristics of reservoir water and its impact on zooplankton

Chapter: 6 Conclusion And Suggestions

This will be last chapter in which conclusion will be drawn and suggestions will be put forth for improving the quality of Reservoir water.

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Reference

1. Hill M.O., Diversity and Evenness: A unifying notation and its consequences, Ecology, 54, 427-432 **(1973)**
2. Pradhan A, Bhaumik P, Das S, Mishra M, Khanam S, Hoque B.A., Mukherjee I, Thakur A.R., and Chaudhuri S.R., zooplankton Diversity as Indicator of Water Quality for Fish Cultivation, Ameri. J Envir Sci, 4, 406-411 **(2008)**
3. Bellingham K., Physicochemical Parameters of Natural Waters, Stevens Water Monitoring Systems, Inc. (accessed on 20/07/2012 from http://www.stevenswater.com) **(2012)**
4. Omaka O.N, Nwabue F.I, Itumoh E.J, Oroke E.C and Igwe D.O, Physicochemical parameters and nutrients variations of streams and rivers in Abakaliki, Ebonyi, State, Nigeria. J Global Nest, 16 (1) 114-123 **(2014)**
5. Talling J.F and Talling T.B., The chemical composition of African Lake waters, Int. Revue der Gesamten Hydrobiol. 50(3) 421- 463, **(1965)**
6. Robert D.S, Robert W.H and Evereff .L.G zooplankton distributions and water quality indices of Lake head (Colorado River). Phycol, 10, 232-333, **(1974)**
7. Rahman S. and Hussain M.A., A study of the abundance of zooplankton of a culture and non-culture pond of the Rajshahi University Campus, Rajshahi University, Uni J Zoology, 27, 35-41, **(2008)**
8. Pielou E.C., The measurement of diversity of different types of biological collections, J Theor Biol, 13,131-141. **(1966)**
9. Divya K.S, Murthy M.S and Puttaiah E.T A comparative study of the growth of planktons in surface water samples and in the formation of algal booms, Inter J Inno Res Sci Eng Tech, 2 (7), 2736-2747 **(2013)**
10. Singh K.K and Sharma B.M, Ecological productivity studies of the macrophytes in Kharungpat Lake, Manipur, Northeast India, Int J Geol Ear Envir Sci, 2, 58-71. **(2012)**
11. Munawar M, Limnological studies on freshwater ponds of Hyderabad, India, Biocenase Ibid, 45,1-32. **(1974)**

Suvarna Lakshmi

12. Chaturvedi R.K, Sharma K.P, Sharma K, Bhardwaj S and Sharma S., Plankton community of polluted water around Sanganer, Jaipur, India, J Envir Poll, 6, 77-84, **(1999)**

13. Giripunje M.D, Fulke A.B, Khairnar Meshram P.U. and Paunikar W.N., A review of plankton ecology in freshwater lakes of India, Lakes, Reservoir Ponds, 7(2), 127-141, **(2013)**

14. Ahmad M.S., Ecological survey of some algal flora of polluted habitats of Darbhanga, J Environ Pollution, 3, 147-151, **(1996)**

15. Senthilkumar R. and Sivakumar K. Studies on zooplankton diversity in response to a biotic factor in veeranam lake in the cuddalore district of Tamil Nadu, India, J Envir Biol, 29, 747-752, **(2008)**

16. Laskar H.S and Gupta., Phytoplankton diversity and dynamics of Chatla Floodplain Lake, Barak Valley, Assam, northeast India, A seasonal study, J Environ Biol, 30, 1007-1012, **(2009)**

17. Boyd C.E., Water quality management of pond fish culture, Elsevier, Sci Pub. Co., Amsterdam, Oxford, New York, 318, **(1982)**

18. Mathivanan V. and Jayakumar S., The studies of plankton fluctuation in a reservoir at Annamalai Nagar, Tamil Nadu, Proc. Nat. Sym. Recent trends in Indian wildlife research, AVC College, Mayiladuthurai, Tamil Nadu, India. **(1995)**

19. Mohapatra M.R., Textbook of Environment Microbiology, I.K. International Publishing House Pvt Ltd, New Delhi, India, **(2008)**

20. Ramachandra T.V and Solanki M., Ecological assessment of lentic water bodies of Bangalore, ENVIS Technical report: 25, The Ministry of Science and Technology, Government of India, 1-103, **(2007)**

21. Reynolds C.S., The response of zooplankton communities to changing lake environment, Schweiz zoo Hydrol,49 ,220-236, **(1987)**

22. Akbay N, Anul. N,Yent. S, Soyupak. S and Yurterl .C., Seasonal distribution of large plankton in Keban dam reservoir, plank.res, 21(4), 771-787, **(1999)**

23. Khanna D. R and Singh. R. K., Seasonal fluctuation in plankton of Shuswa river at Raiwala, Dehradun, Env. Cons. J.1(2), 89-92, **(2000)**

Swarna Sakshi

24. Unni. K. S and Pawar .S., The zooplankton along of pollution gradient in the river, India- a multivariable approach,Hydrobiologist, 430, **(2000)**

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